IJBB
International Journal of Biotechnology and Biomedicine
Vol. 3 No2; July 2026 https://doi.org/10.31674/ijbb.2025.v03i02.004

Awareness of Antibiotic Use in Aquaculture Products among Bangladeshi Students in Malaysia

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Article received on 8th June 2026.
Revision received on 9th July 2026.
Accepted on 11th July 2026.

Abstract
Antimicrobial resistance (AMR) is the resistance developed by bacteria due to the overuse of antibiotics in fish farming. A cross-sectional descriptive study was conducted to survey the knowledge and attitudes of Bangladeshi students residing in Malaysia regarding antibiotic use in fish farming products. To gather the information, a structured online questionnaire was provided via Google Forms with 25 questions and five sections, and this was sent to 120 Bangladeshi students studying in Malaysia. The statistical analysis of the data was performed using descriptive statistics, Chi-square tests of independence, and multivariate logistic regression ($\alpha = 0.05$). Overall, 76.7% of respondents were aware of the use of antibiotics in aquaculture, and 72.5% thought that too much antibiotic use could affect human health. Regarding concerns, 40% were slightly concerned about the presence of antibiotic residues in fish, 22.5% were very concerned, and 80.8% indicated that information about antibiotic residues would affect their seafood purchasing habits. A statistically significant bivariate association with concern about antibiotic residues was found for fish consumption frequency ($\chi^2 = 41.365$, df = 9, $p < .001$, Cramer's V = 0.34); the remaining four of the total five chi-square tests were not statistically significant. However, multivariate logistic regression, which controlled for gender, level of study, and frequency of fish consumption, showed that gender (OR = 5.00, p = .029) and level of study (Master's vs. Bachelor's, OR = 12.51, p = .005) were significant independent predictors of awareness, an effect that could not be detected by bivariate testing alone. The results show that although these students have some awareness, there is a lack of critical knowledge about food safety among Bangladeshi expatriate students, and food-safety education programs should be delivered digitally and in multilingual formats to help make informed and safe food choices.

Keywords: Antibiotic; Antimicrobial resistance; Aquaculture; Food Safety; Fish Consumption; Awareness; Bangladeshi Students.

1.0 Introduction

Most of the fish consumed in the world is now being farmed, and the main sources of such farmed fish are the Asian countries, including Bangladesh, China, and Vietnam (Food and Agriculture Organization of the United Nations, 2022), while previously the majority of the fish consumed in the world was caught from the sea and rivers. In high-density fish farming,

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antibiotics are added to feed and water to prevent the spread of bacterial infections, to reduce fish diseases, and to ensure high fish production. Overuse or misuse of antibiotics allows bacteria to 'resist' the effect of the antibiotic, also known as antimicrobial resistance (AMR). This reduces the effectiveness of antibiotics, making treatment more complex and public health risks greater. WHO (2021) states that AMR now poses one of the biggest public health problems in the world.

Bangladesh is one of the important fish-producing and consuming countries of the world. Fish farming plays a significant role in food production and economic stability. In Bangladesh, fish is an important food for the people as a primary source of animal protein. Fish is also a vital component of the Bangladeshi diet, even outside of Bangladesh, because it is an integral part of their cultural diet (Pham *et al.*, 2015). Data on public awareness of antibiotic use in food-producing animals and antimicrobial resistance in Malaysia are only moderately available nationally (Fatokun *et al.*, 2024), and, in general, food-safety training and knowledge gaps have been reported in Malaysia for migrant/expatriate populations, which typically have limited access to structured and culturally tailored food-safety education (Alkhaldi *et al.*, 2025). Furthermore, it has been discovered that international tertiary education students in general experience unique challenges when adjusting to their diet and food environment after moving overseas, such as issues with eating familiar foods and with food safety norms (Shi *et al.*, 2024). This is of particular relevance for the study of Bangladeshi students because fish were a key part of their culture and their food intake, and they were not familiar with the aquaculture supply chain as well as the food labeling environment in Malaysia, which might make them particularly vulnerable to food-safety knowledge gaps that have not been documented before for this specific population. The significant population of Bangladeshi students in Malaysia is growing steadily. Fish is regularly included in their diet. Malaysia has a prescribed food safety regulation for the food environment. Information is not available about their level of knowledge about food safety. No research on their knowledge of the antibiotic residue in fish farming products was found (Lulijwa *et al.*, 2020). The more people know about food safety, the better informed they will be about what they buy, which in turn will help to reinforce the trend toward purchasing safer food. But research by Van Boeckel *et al.* (2015) and Mao *et al.* (2015) shows that in several countries in South and Southeast Asia, even among the educated class, there is a lack of awareness of antibiotic use and its potential health risks. International students, on the one hand, eat what they ate back home, and on the other hand, they are also experiencing the food environment of the country they are studying in. As a result, they have difficulty adapting to the new food environment, but at the same time, they also have the opportunity to gain knowledge about food safety (Verbeke & Vackier, 2005). Based on this background, the present study aims to:

a) To bring to the fore the demographic profile and fish consumption pattern of the Bangladeshi students studying in Malaysia.

b) To evaluate their knowledge about the use of antibiotics and residues in aquaculture.

c) Analyze their attitudes to food safety risks related to antibiotics and their buying choices. d) To explore significant bivariate and multivariate relationships between the chosen variables through Chi-square analysis and logistic regression.

2.0 Materials and Methods

2.1 Study Design

The data used in this survey were collected through a cross-sectional quantitative design. The survey was conducted to collect and analyze data assessing Bangladeshi students in Malaysia regarding the use of antibiotics in aquaculture (Creswell & Creswell, 2018).

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2.2 Sample Size / Study Population

The target population of this study is about 9,000 Bangladeshi students who are studying in Malaysia. For an infinite or large population, Cochran's formula indicates that a sample of about 368-384 should be sufficient to represent the population (at a 95% confidence level, a 5% margin of error, and p = 0.5). The number of Bangladeshi students who are willing to participate in the present study through an online questionnaire is 120, which is less than the calculated sample, making the present study an exploratory/pilot study rather than a totally representative study – addressed further in Section 4.5. The majority of the respondents were undergraduate students, while some were Master's and PhD students studying in public and private universities in Malaysia. Here, non-probability sampling techniques (convenience sampling and snowball sampling) were employed to recruit students through the association of Bangladeshi students, social media, and WhatsApp communities. The inclusion criteria were that students had to be (i) currently studying in Malaysia, (ii) Bangladeshi nationals, and (iii) able to provide informed consent.

2.3 Study Period

The cross-sectional study was conducted from 10th March 2026 to 5th April 2026 among Bangladeshi students at various public and private universities in Malaysia.

2.4 Study Survey Instrument

A Google Form was used to develop an online questionnaire consisting of 25 closed-ended questions in five sections. The items were based on questionnaires used in similar studies on food-safety awareness (Haidari *et al.*, 2022; Osaili *et al.*, 2021) with some adjustments to align with the context of Bangladeshi expatriate students. Future research should continue pilot testing the instrument and should involve formal validation (face/content validation, Cronbach's alpha reliability testing), which was not conducted in the current study. In the demographic details (Q1-Q6), the variables that were examined were age, gender, education, university attended, and length of time living in Malaysia. These variables describe the target population and are explored for the relationship. Fish Consumption Behavior (Section B, Q7-Q11) was designed based on previous research on seafood consumer behavior encompassing the frequency of fish/seafood consumption, preferred fish (farmed/wild), where to buy fish, and variability of fish consumption (Dang *et al.*, 2021). The Awareness of Antibiotic Use in Aquaculture (AQUA) section (Q12-Q17) was developed focusing on past surveys about antibiotic use in aquaculture (Dandi *et al.*, 2024; Pham *et al.*, 2015), as well as consumer awareness surveys in Malaysia and Asia (Devadas *et al.*, 2025; Goh *et al.*, 2023). The questions in Section D (Q18-22) were created based on a literature review of consumers' food safety concerns and purchasing behavior (Wang *et al.*, 2026; Mazuki *et al.*, 2025). Section E (Q23 - Q25) was formulated based on consumer practices on salience, control, and maintenance of safety behaviors in purchasing a product (Mongi *et al.*, 2022; Aspian *et al.*, 2024).

2.5 Data Analysis

A total of 120 responses were collected through the online questionnaire via Google Forms. The data were first processed and cleaned in Microsoft Excel and analyzed in SPSS. Participant characteristics were summarized using descriptive statistics (frequencies and percentages. Five variable pairs were entered into the SPSS software, and chi-square tests of independence were performed for these variable pairs as listed below. As additional tests for journal review, the authors also rechecked and extended analyses using Python (pandas and SciPy), which included analyses of expected cell frequencies for each test and, for the two tests (Level of

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study × Concern about antibiotic residues; and Fish consumption frequency × Concern about antibiotic residues) where an expected cell count below 5 occurred on more than 20% of cells, a Monte Carlo exact test (100,000 simulations) was used to verify the significance of the asymptotic Chi-square result. Since five independent tests were run, a Bonferroni correction was employed to control for multiple comparisons (α was adjusted to 0.01). A measure of effect size was calculated for each test as Cramer's V, and 95% confidence intervals were computed using bootstrap resampling (2000 replications). To compare the effect of each predictor in the multivariate model, without being confounded by the other predictors, a multivariate binary logistic regression was performed to predict awareness of antibiotic use in aquaculture (yes/no) from the simultaneous effect of gender, level of study, and fish consumption frequency. Small cell counts of adjacent fish-frequency categories (Daily, n = 3) were merged with the adjacent category (3–4 times/week) for model stability.

i. Gender × Awareness of antibiotic use
ii. Level of study × Awareness of antibiotic use
iii. Level of study × Concern about antibiotic residues
iv. Fish consumption frequency × Concern about antibiotic residues
v. Awareness of antibiotic use × Fish or Seafood purchasing decision

2.6 Ethical Considerations

This study was approved by the Ethics Committee of Lincoln University College. The ethical approval number is LUC/RMC/ETHICAL/2025/001. The study involved anonymous, voluntary participation, with no collection of personally identifiable information, and posed minimal risk to the participants, so it was conducted in accordance with standard institutional ethical guidelines for studies that involve a survey-based method of data collection. This study was conducted on an entirely voluntary basis, with all participants fully briefed on the purposes before giving informed consent. All responses were anonymous and used only for academic research, and no personally identifiable information (phone number, email, name, etc.) was collected.

3.0 Results

3.1 Demographic Information

This survey was conducted with 120 students from Bangladesh (Table 1). Most respondents were aged 18–25 years (58.3%), followed by 28–33 years (32.5%), with the remaining 9.2% aged 33 years and above. There were more male respondents than female respondents. A total of 72 students were undergraduate (Bachelor's) students, 39 were Master's students, and there were fewer PhD students. Most of the participants were in the Business/Management field, followed by a significant number in Engineering/Technology, the rest being spread across Life Sciences/Food Science, Social Sciences/Humanities, and other areas. The majority of respondents had been living in Malaysia for 1-3 years. The participants were mainly from Lincoln University College, with some from other universities like Alpha University College, City University, Sunway University, Taylor's University, and Universiti Malaya.

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Table 1
Demographic Information of Respondents (n = 120)

Variable	Category	n	%
Age Group	18–25 years	70	58.3
	28–33 years	39	32.5
	33 years and above	11	9.2
Gender	Male	95	79.2
	Female	25	20.8
	Prefer not to say	0	0
Level of Study	Bachelor	72	60
	Masters	39	32.5
	PhD or others	9	7.5
Field of Study	Life Sciences / Food Science	22	18.3
	Engineering / Technology	41	34.2
	Business / Management	47	39.2
	Social Sciences / Humanities	3	2.5
	Others	7	5.8
Duration in Malaysia	Less than 1 year	47	39.2
	1–3 years	64	53.3
	More than 3 years	9	7.5
Total		**n=120**	**100**

Note. Percentages may not sum to 100 due to rounding. There were no respondents aged 26 and 27 years.

3.2 Fish and Seafood Consumption Behavior

Most students consumed fish once or twice a week, more frequently than any other consumption category. Wild fish was preferred over farmed fish among these Bangladeshi students. Of the 120 respondents, 64 (Table 2) usually purchased fish from supermarkets/hypermarkets, and 49 preferred local Bangla markets. Tilapia, carp fish, and tuna or salmon were the most commonly purchased fish types. As fish provides important nutrients, it was widely regarded as a healthy dietary choice; 98 of the 120 respondents considered fish an important part of their diet.

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Table 2
Fish and Seafood Consumption Behavior of Respondents (n = 120)

Variable	Category	n	%
Fish Consumption Frequency	Rarely / Never	25	20.8
	1–2 times per week	67	55.8
	3–4 times per week	25	20.8
	Daily	3	2.5
Fish Preference	Farmed Fish	14	11.7
	Wild Fish	69	57.5
	No preference	37	30.8
Usual Purchase Location	Supermarket / Hypermarket	64	53.3
	Local Bangla Market	49	40.8
	Restaurant	4	3.3
	Online Grocery	3	2.5
Fish type	Tilapia	27	22.5
	Catfish	18	15.0
	Carpfish	26	21.7
	Tuna or Salmon	24	20.0
	Others	25	20.8
Fish is important in the diet	Yes	98	81.7
	No	22	18.3
Total		**n=120**	**100**

Note. Percentages may not sum to 100 due to rounding. This section is Section B of the survey.

3.3 Awareness of Antibiotic Use in Aquaculture

This study showed that 92 of the 120 students were aware that antibiotics are used in aquaculture. Of these, 80 students knew antibiotics are used specifically to treat fish diseases (Table 3). As shown in Table 3, 72.5% of students recognized that excessive antibiotic use is harmful to human health. Most students (55%) reported the internet as their primary source of food-safety information.

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Table 3
Awareness of Antibiotic Use in Aquaculture among Respondents (n = 120)

Variable	Category	n	%
Heard about antibiotic use in aquaculture	Yes	92	76.7
	No	28	23.3
Antibiotics are used to treat fish diseases	Yes	80	66.7
	No	8	6.7
	Not sure	32	26.7
Antibiotic residues can remain in fish	Yes	79	65.8
	No	4	3.3
	Not sure	37	30.8
Excessive antibiotic use affects human health	Yes	87	72.5
	No	4	3.3
	Not sure	29	24.2
Received information on antibiotic use in aquaculture	Yes	70	58.3
	No	50	41.7
Main source of food safety information	Internet/Websites	66	55
	Social Media	30	25
	News / Television	12	10
	Friends / Community	12	10
Total		**n=120**	**100**

Note. This section is Section C of the survey, where awareness of antibiotic use was measured.

3.4 Perception and Attitudes

The results indicate that 40% of respondents were slightly concerned about antibiotic residues in fish, while 22.5% were very concerned (Table 4). A similar proportion (34.2%) believed farmed fish was safe to eat, while 31.7% were unsure. The majority of respondents (80.8%) reported that information about antibiotic residues would influence their fish or seafood purchasing decisions. As shown in Table 4, most students (86.7%) agreed that the government should regulate antibiotic use in aquaculture, and 80% were willing to pay more for antibiotic-free fish.

Table 4
Perceptions and Attitudes Toward Antibiotic Residues in Fish Products (n = 120)

Variable	Category	n	%
Concern about antibiotic residues in fish	Not concerned	22	18.3
	Slightly concerned	48	40
	Moderately concerned	23	19.2
	Very concerned	27	22.5
Farmed fish is safe to eat	Yes	41	34.2
	No	41	34.2
	Not sure	38	31.7
Antibiotic info influences Fish or seafood purchasing decisions	Yes	97	80.8
	No	23	19.2
	Yes	104	86.7

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The government should regulate antibiotic use	No	16	13.3
Willing to pay more for antibiotic-free fish	Yes	96	80
	No	24	20
Total		**n=120**	**100**

3.5 Consumer Practices

Among 120 respondents,32.5% never checked food safety labels when buying seafood and fish, and 25% always checked these labels (Table 5). From this survey,42.5% of students expressed concerns about not buying fish due to antibiotic use. Finally, respondents from Table 5 were positive about learning more about food safety and antibiotic use in aquaculture.

Table 5
Consumer Practices

Variable	Category	n	%
Check food safety labels when buying seafood	Never	39	32.5
	Rarely	17	14.2
	Sometimes	34	28.3
	Always	30	25
Avoided buying fish due to antibiotic concerns	Yes	48	40
	No	51	42.5
	Not sure	21	17.5
Learn more about food safety and antibiotic use in aquaculture	Yes	111	92.5
	No	9	7.5
Total		**n=120**	**100**

Note: This section was entered into the questionnaire.

3.6 Chi-Square Test

Chi-square analysis indicated that most tested associations were not statistically significant ($p > .05$), and this held even after verifying the assumptions and applying stricter significance criteria. For the two tests where expected cell frequency assumptions were violated (Level of study × Concern and Fish consumption frequency × Concern), Monte Carlo exact tests confirmed the same conclusions as the asymptotic Chi-square tests (exact $p = .974$ and exact $p < .001$, respectively). After applying a Bonferroni correction for the five tests conducted (adjusted $\alpha = 0.01$), only fish consumption frequency remained significantly associated with concern about antibiotic residues ($p < .001$, $\chi^2 = 41.365$, Cramer's V = 0.34, 95% CI [0.27, 0.45], indicating a moderate effect. The remaining four associations were non-significant with small effect sizes (Cramer's V ranging from 0.08 to 0.22; Table 6).

Table 6
Chi-Square Tests of Independence: Summary of Results (n = 120)

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No.	Variables	χ^2 Value	df	*p*-value	Cramer's V [95% CI]	Significant ($p < .05$)?
1	Gender × Awareness of antibiotic use in aquaculture	1.326	1	.250	0.11[0.01,0.03]	No
2	Level of study × Awareness of antibiotic use in aquaculture	5.601	2	0.061	0.22[0.09,0.38]	No
3	Level of study × Concern about antibiotic residues in fish	1.337	6	.974	0.08[0.08,0.27]	No
4	Fish consumption frequency × Concern about antibiotic residues	41.365	9	<0.001	0.34[0.27,0.45]	Yes
5	Awareness of antibiotic use × Fish or Seafood purchasing decision	2.085	1	.149	0.13[0.01,0.33]	No

Note. df = degrees of freedom. Cramer's V effect size is shown with a 95% bootstrap confidence interval (2,000 replications). [1]Expected cell frequency assumption violated (>20% of cells with expected count <5); p-value shown is from a Monte Carlo exact test (100,000 simulations) rather than the asymptotic Chi-square distribution. Significance was evaluated at Bonferroni-adjusted $\alpha = .01$ to control for multiple comparisons across the five tests.

3.7 Multivariate Logistic Regression

A binary logistic regression was done to determine the combined effect of gender, level of study, and frequency of fish consumption on awareness of antibiotic use in aquaculture (n = 120; model $\chi^2 = 36.15$, df = 5, $p < .001$; McFadden's pseudo $R^2 = 0.28$). Of note, gender and level of study were also statistically significant independent predictors of awareness in the multivariate model but not in the univariate chi-squared tests (Table 7), suggesting that, in this sample, the effect became detectable only after controlling for other predictors in a multivariate model.

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Table 7
Multivariate Logistic Regression Predicting Awareness of Antibiotic Use in Aquaculture (n = 120)

Predictor	Reference category	Odds Ratio	95% CI	p-value
Gender: Male	Female	5.00	[1.17, 21.29]	.029
Level of study: Masters	Bachelor	12.51	[2.19, 71.51]	.005
Level of study: PhD/others	Bachelor	0.57	[0.10, 3.23]	.529
Fish frequency: 3+ times/week	1–2 times/week	0.55	[0.14, 2.09]	.379
Fish frequency: Rarely/Never	1–2 times/week	0.06	[0.02, 0.21]	<.001

Note. Reference categories: Female (gender), Bachelor's degree (level of study), 1–2 times/week (fish consumption frequency). "3+ times/week" combines the original "3–4 times/week" and "Daily" categories (collapsed due to small cell size in the Daily category). Model fit: $\chi^2(5) = 36.15$, $p < .001$; McFadden's pseudo $R^2 = 0.28$.

4.0 Discussion

4.1 Level of Awareness

The percentage of respondents who reported hearing about antibiotic use in aquaculture (76.7%) is consistent with the rising global attention on the use of antimicrobials in food animals (Van Boeckel *et al.*, 2015). The level of awareness may be attributed to the high education level of the population in this sample and the high exposure to media, as found by Osaili *et al.* (2021), who found that formal education and media exposure are correlated with food-safety awareness among Jordanian university students. Interestingly, the awareness among these Bangladeshi student consumers is similar and, in some cases, higher than that of antimicrobial use and resistance among the shrimp aquaculturists, who are the ones who will be using antibiotics in the supply side of the antimicrobial use and resistance supply chain in Peninsular Malaysia, as reported by Devadas *et al.* (2025) for the shrimp aquaculture sector. This implies that consumer-side awareness of the aquaculture situation is not lagging, but may be even better than producer-side awareness in the local aquaculture industry in Malaysia, indicating the existence of gaps in awareness along the entire food system, not just among consumers. Both univariate Chi-square tests (Table 6: $\chi^2 = 1.326$, df = 1, $p = .250$; Table 6: $\chi^2 = 5.601$, df = 2, $p = .061$) were non-significant, but the multivariate logistic regression (Table 7) showed that both gender (male students: OR = 5.00, 95% CI [1.17, 21.29], $p = .029$) and level of study (Masters vs. Bachelor: OR = 12.51, 95% CI [2.19, 71.51], $p = .005$) were significant independent predictors of awareness. The results of the multivariate analyses also differed from those of the bivariate analyses, further underscoring that in simple bivariate analyses, the effects of the variables "gender" and "academic level" were confounded, and suggesting the usefulness of multivariate modeling even in relatively small samples.

4.2 Concern and Consumer Practices

This finding is consistent with the results of Dang *et al.* (2021), who found that increased awareness of food-safety risks was associated with increased consumer anxiety among fish farmers and consumers in Vietnam. Unlike Dang *et al.* (2021), the present sample represents a

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non-farming, expatriate student group, indicating that this concern-driven willingness to pay a premium transcends producer communities to consumers in general. This suggests that there is market potential for certified antibiotic-free aquaculture products among safety-conscious expatriate consumers in Malaysia, provided credible certification and labeling systems.

4.3 Variables Relation

One of the five bivariate relationships tested was statistically significant: Frequency of fish consumption was significantly associated with concern about antibiotic residues (χ^2=41.365, df=9, p< .001, Cramer's V = .34), conforming to the general expectation that the more frequently fish is consumed, the more exposure to the information about food safety and, in turn, the greater the awareness of risk. Gender (χ^2 = 1.326, df = 1, p = .250), level of study (χ^2 = 5.601, df = 2, p = .061), level of study and concern (χ^2 = 1.337, df = 6, p = .970), and awareness and purchasing decision (χ^2 = 2.085, df = 1, p = .149) were all statistically non-significant at the bivariate level. As mentioned in Section 3.7, however, in a multivariate logistic regression analysis of the data, when the three variables of gender, level of study, and frequency of fish consumption were modeled together in predicting awareness, both gender and level of study were found to be significant independent predictors – meaning that the effects of both these variables were present but masked in the bivariate testing. It suggests that consumption patterns and demographic factors (when adequately modeled play a role in this sample's awareness and concern regarding food safety, and that multivariate methods can provide a more complete picture than univariate testing alone.

4.4 Implications

The findings have practical applications. The internet was the primary source of food-safety information for 55% of those surveyed, and digital and social media-based food-safety awareness programs would likely be the most effective way to reach them and should be prioritized over traditional print or face-to-face materials. Food safety and AMR should be included in the orientation program at Lincoln University College and other universities in Malaysia that have international students, preferably in a multilingual (Bengali/English/Malay) form, to avoid language barriers faced by international students. Better labeling of the antibiotic residue on aquaculture products sold in Malaysia would also help the 80% of respondents who indicated that they would be willing to pay more for certified products that were antibiotic-free.

4.5 Limitations

There are some limitations of this study. The results of this study cannot be extrapolated to the general population of Bangladeshi students in Malaysia because it used convenience sampling and snowball sampling, and the number of students (n = 120) is also fewer than the number suggested by a priori sample-size determination (≈368 – 384). There was no pilot testing or psychometric validation of the questionnaire (such as Cronbach's alpha reliability) before it was used; it was adapted from questionnaires already used. Social desirability or self-report bias may affect the responses to all self-reported surveys. The design is cross-sectional, meaning that information is gathered only once, and it cannot conclude any causal relationships between variables. Future studies should be conducted using probability sampling with a sufficient number of participants, a pilot-tested and validated survey, and longitudinal or mixed methods designs to extend these preliminary results.

Conclusion

This study provides the first available insight into food-safety awareness regarding antibiotic use in aquaculture products among Bangladeshi expatriate students in Malaysia. Most students were aware that antibiotics are used in aquaculture, but awareness of the specific health risks of antibiotic residues and the process of antimicrobial resistance was more limited. At the bivariate level, only fish consumption frequency was significantly associated with concern about antibiotic residues ($\chi^2 = 41.365$, $df = 9$, $p < .001$); however, multivariate logistic regression additionally identified gender and level of study as significant independent predictors of awareness, indicating that these demographic factors do play a meaningful role that simple bivariate testing alone did not detect. As an exploratory study based on a convenience sample, these findings should be treated as preliminary; they nonetheless offer a useful starting point for strengthening food-safety education, university orientation programs, and public-health policy for international student communities in Malaysia.

Acknowledgements

The author conveys deep appreciation to Supervisor Dr. Asita Elengoe, Associate Professor, Department of Biotechnology at Lincoln University College, for direction and assistance throughout the whole period of research. Sincere thanks to all Bangladeshi students who voluntarily participated in this survey to make the study successful.

Conflict of Interest

The author has no personal or financial interests involved in this research work, authorship, or publication of this article.

Author's Contributions

Asita Elengoe and Farjana Khanom provided the original idea for this study and contributed to various research tasks. The first draft was done by Asita Elengoe and Farjana Khanom. Manuscript editing and reviewing were done by Asita Elengoe and Farjana Khanom. The final manuscript was read and approved by both writers, who also committed to taking full responsibility for the work.

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APPENDIX

SURVEY QUESTIONNAIRE

Awareness of Antibiotic Use in Aquaculture Products among Bangladeshi Students in Malaysia

Participant Consent & Information

This survey is for academic research purposes only. Your participation is entirely voluntary and anonymous. There are no right or wrong answers. The survey takes approximately 5 minutes to complete. By proceeding, you consent to participate. For inquiries, contact the research team at: [farjana.masterscholar@lincoln.edu.my]

Section A: Demographic Information	
Are you a Bangladeshi Student currently studying in Malaysia?* o Yes o No	
Q1. Age group *	o 18–25 years o 28–33 years o 33 years and above
Q2. Gender *	o Male o Female o Prefer not to say
Q3. Level of study *	o Bachelor o Masters o PhD or others
Q4. Field of study *	o Life Sciences / Biology / Food Science o Engineering / Technology o Business / Management o Social Sciences / Humanities o Others
Q5. University name *	o (short answer text)
Q6. How long have you been living in Malaysia? *	o Less than 1 year o 1–3 years o More than 3 years

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International Journal of Biotechnology and Biomedicine
Vol. 3 No2; July 2026 https://doi.org/10.31674/ijbb.2025.v03i02.004

Section B: Fish Consumption Behavior	
Q7. How often do you consume fish or seafood?	○ Rarely / Never ○ 1–2 times per week ○ 3–4 times per week ○ Daily
Q8. Do you prefer farmed fish or wild fish? *	○ Farmed Fish ○ Wild Fish ○ No preference
Q9. Where do you usually buy fish or seafood? *	○ Supermarket / Hypermarket ○ Local Bangla market ○ Restaurant ○ Online grocery
Q10. Which fish do you consume most often? *	○ Tilapia ○ Catfish ○ Carp fish ○ Tuna or Salmon ○ Others
Q11. Do you consider fish an important part of your diet? *	○ Yes ○ No
Section C: Awareness of Antibiotic Use in Aquaculture	
Q12. Have you heard about antibiotic use in aquaculture? *	○ Yes ○ No
Q13. Do you think antibiotics are used to treat diseases in fish farming? *	○ Yes ○ No ○ not sure
Q14. Do you believe antibiotic residues can remain in fish products? *	○ Yes ○ No ○ Not sure
Q15. Do you think excessive antibiotic use in aquaculture can affect human health?*	○ Yes ○ No ○ Not sure
Q16. Have you ever received information about antibiotic use in aquaculture? *	○ Yes ○ No
Q17. What is your main source of food safety information? *	○ Internet websites ○ Social media ○ News / Television ○ Friends / Community
Section D: Perception and Attitudes	
Q18. How concerned are you about antibiotic residues in fish products? *	○ Not concerned ○ Slightly concerned ○ Moderately concerned ○ Very concerned
Q19. Do you think farmed fish are safe to eat? *	○ Yes ○ No ○ Not sure

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International Journal of Biotechnology and Biomedicine
Vol. 3 No2; July 2026 https://doi.org/10.31674/ijbb.2025.v03i02.004

Q20. Would information about antibiotic residues influence your seafood purchasing decision? *	○ Yes ○ No
Q21. Do you think governments should strictly regulate antibiotic use in aquaculture? *	○ Yes ○ No
Q22. Are you willing to pay more for certified antibiotic-free fish? *	○ Yes ○ No
Section E: Consumer Practices	
Q23. Do you check food safety labels or certifications when purchasing seafood? *	○ Never ○ Rarely ○ Sometimes ○ Always
Q24. Have you ever avoided buying fish due to concerns about antibiotic residues? *	○ Yes ○ No ○ Not sure
Q25. Would you like to learn more about food safety and antibiotic use in aquaculture? *	○ Yes ○ No